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The Effect of Kindergarten Program Types and Class Size on Early Academic Performance

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Abstract
The effects of kindergarten program organizations (class size and length of school day) on academic achievement have been studied for decades but the results are still not clear. Using data from the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99, we explored the relationship between the two kindergarten program organizations and first-time kindergartners' cognitive (a combination of reading, math, and general knowledge) gains at the end of the kindergarten year. The results showed some slight positive

relationship between small class size and achievement gain, and a positive relationship between full-day program and the gain scores. It is also found that these effects are more pronounced for children from minority, low-income backgrounds. Although we cannot draw a firm conclusion about the benefit of small class size (less than 17) on academic achievement yet, we have found that children in large classes (more than 24) made the least gains. Policy makers should consider the possibility of reducing very large class size and make full-day programs available to young children, particularly to poor minority children.

Since the announcement of Goal #1: "By the year 2000, all children in America will start school ready to learn" (U. S. Department of Education, 1994), the importance of early childhood education could not have been given more emphasis. This goal echoes what many early childhood advocates have been saying for a long time. Families, schools, and communities have the *responsibility and obligation* to ensure children's school readiness (Kagan, 1990).

Increasingly, as the nation moves to raise educational standards for children's performance in school (National Education Goals Panel, 1997), kindergarten characteristics such as class size, length of school day are looked upon as sources of variability on children's readiness for school (Pianta & Cox, 1999). Efforts to provide kindergarten programs that give children an optimal environment for academic growth include decreasing class size (Achilles, Harmon, & Egelson, 1995), and moving from part-day to full-day programs (Morrow, Strickland, & Woo, 1999). These strategies can have substantial costs but are aimed at increasing the time and personal attention available for each child in the kindergarten classroom. Because the debate about the effects of kindergarten program organizations on young children's academic readiness has implications for social and educational policy, clarification of the nature and extent of kindergarten program organizations as sources of variability on children's developmental status is a pressing scientific concern.

Related Literature

Research on Class Size

The debate on class size and its effects can be categorized into three broad areas: (a) studies that find positive effects on academic achievement, (b) studies that find small to moderate relationship, and (c) studies that find there are no effects of small class size on student achievement.

The first line of research found the existence of a relationship between class size and students' academic performance. Bennett's (1996) survey of teachers' and head teachers' views shows that practitioners believe that large class sizes affect teaching and learning and are particularly aware that larger classes could have an adverse effect on the amount of teacher attention. Betts and Shkolnik (1999) modeled relationships between class size and teacher time allocation based on a secondary analysis of a national survey of students in middle and high schools in the United States. Teachers were asked to estimate retrospectively the minutes spent per week in group instruction, individual instruction per student, and percentage time in instructional activities. The results show some evidence that

teachers substitute group instruction for individual instruction as class size increases and devote less time to group instruction and more to individual instruction in smaller classes. There was a small effect on percentage of overall instructional time. Molnar and others (1999) report results from the Wisconsin Student Achievement Guarantee in Education (SAGE) project, a 5-year K-3 project began in the 1996-1997 school year, in which participating schools were required to reduce rations to 15 students per teacher. From interviews and questionnaires teachers were asked to rank items according to the extent to which they were affected by reduced class size. The teacher behaviors that received the highest rankings were: more individualized instruction; more teaching time; more discussion, sharing, and answering; more hands-on activities; and more content coverage. It might be expected to be particularly important to maximize the amount of teaching and individual support for the youngest children in school.

Using the techniques of meta-analysis to provide a quantitative synthesis of the relevant research, Glass and his associates clearly established that reduced class size resulted in increased academic achievement, the relationship being particularly marked in studies involving the random assignment of subjects to groups (Glass, McGaw, & Smith, 1981; Glass, Cahen, Smith, & Filby, 1982; Glass & Smith, 1978). The most widely quoted randomized experimental research is Tennessee STAR project (Nye, Hedges, & Konstantopoulos, 1999, 2000, 2001, 2002). Although findings are still contentious (see Grissmer, 1999; Hanusheck, 1999; Prais, 1996), for instance, in regard to whether low-achieving students equally benefit from small classes (Nye, Hedges, & Konstantopoulos, 2002), there is generally agreement that the STAR project is an impressive large-scale study, providing evidence that smaller classes (below 20) have positive effects on pupil academic performance (Finn & Achilles, 1990), and that the effects are most pronounced immediately after school entry, that is, if the youngest children in school are placed in small classes (e.g., Nye, Hedges, & Konstantopoulos, 2000). In all, this line of research provides evidence that children in smaller classes often make greater academic gains compared to those in larger classes (Achilles, Harmon, & Egelson 1995; Grissmer, 1999; Lindjord, 1998; Nyhan & Alkadry, 1999) and that it might be expected to be particularly important to maximize the amount of teaching and individual support for the youngest children in school (Blatchford, Moriarty, Edmonds, & Martin, 2002).

The second line of research found a small to moderate relationship between class size and achievement, particularly for minority, low-SES and young children (Lindjord, 1998). In his review of data from Tennessee's Project Star and other research on class size and student achievement, Tomlinson (1990), for example, maintained that findings provided "no support for the idea that 12 years of small classes would produce significant increase in student achievement" (p. 18). Nevertheless, he allowed that disadvantaged minority students seemed to benefit significantly from small classes. Berlin and Cienkus (1999) have likewise remarked "the need for smaller class size is inversely proportional to student's socioeconomic status." In addition, a number of researchers accept that a positive correlation between class size and achievement exists but argue that it holds only in the first years of schooling. Folger and Breda (1999), for example, suggest that the class size effect is concentrated in kindergarten and first grade and that, after first grade, the effects of reducing class size plateaus and then declines. Using both quantitative and qualitative methods, Blatchford, Moriarty, Edmonds and Martin (2002) investigated the relationship between teaching and small class size in British infant schools and found that the young children had benefited from more interaction

with and attention from teachers in small classes.

Indeed, on logical and commonsense grounds it seems likely that the greater the number of young children in a class, the more time teachers will spend on procedural and domestic matters such as taking the registers, lining children up and putting on coats, and dealing with domestic duties such as toileting, accidents, and so forth, and conversely, the less time teachers will spend on instruction and dealing with individual children.

At the other side of the spectrum is the body of literature that argues there is no relationship existed between class size and student achievement. Hanushek (1989) claimed, "The results are startlingly consistent in finding no strong evidence that teacher-student ratios, teacher education, or teacher experience have the expected positive effects on student achievement" (p. 47) and he supported this assertion in a later study (Hanushek, 1999). More recently, Walston, West and Rathbun (2002) also found that small class size has no relationship with kindergartners' academic achievement. Teachers' instructional methods, for instance, might be more important. It appears that reducing class size means little if teachers continue to use the same instructional methods used in larger groupings and if teachers do not capitalize on the opportunity to individualize instruction (Gilman, Swan, & Stone, 1998).

Research on Length of Kindergarten Day

At present, due to greater numbers of single-parent and dual-income families in the workforce who need all-day programming for their young children, as well as the belief by some that all-day programs better prepare children for school, in the fall of 1998, of the 4 million children attending kindergarten in the United States, 55% were in all-day programs and 45% were in part-day programs (West, Denton, & Germino-Hausken, 2000, p. v).

The results of many of the studies conducted on the length of the kindergarten day generally favor whole-day over half-day programs (Morrow, Strickland, & Woo, 1999). Research reported in the 1990s showed consistent positive academic outcomes for all children enrolled in all-day kindergarten (Cryan, Sheehan, Wiechel, & Bandy-Hedden, 1992; Elicker & Mathur, 1997; Fusaro, 1997; Koopmans, 1991). Cryan et al. (1992) conducted a two-phase study that examined the effects of half-day and all-day kindergarten programs on children's academic and behavioral success in school. In the first phase of the study, data were collected on 8,290 children from 27 school districts; the second phase included nearly 6,000 children. The researchers found that participation in all-day kindergarten was related positively to subsequent school performance. Children who attended all-day kindergarten scored higher on standardized tests, had fewer grade retentions, and fewer Chapter 1 placements. Hough and Bryde (1996) looked at student achievement data for 511 children enrolled in half-day and all-day kindergarten programs in 25 classrooms and found that children in the all-day programs scored higher on the achievement test than those in half-day programs on every item tested. Elicker and Mathur (1997) also found slightly greater academic progress in kindergarten and higher levels of first-grade readiness for children in an all-day kindergarten program. Teachers reported significantly greater progress for all-day kindergarten children in literacy, math, and general learning skills. In a meta-analysis of 23 studies on all-day kindergarten, Fusaro (1997) concluded that children who had attended all-day kindergarten achieved at a higher level than children in half-day

kindergarten programs. Also according to de Costa and Bell (2001), children in the full-day kindergarten program experienced significantly greater growth in the pre-requisite skills for reading than did children in the half-day kindergarten program.

In addition, teachers and parents indicated a preference for all-day kindergarten because of the more relaxed atmosphere, more time for creative activities, and more opportunity for children to develop their own interests. Parents reported that all-day kindergarten teachers provided suggestions for home activities more frequently (Hough & Bryde, 1996). Teachers surveyed felt that the all-day program provided more time for individual instruction (Greer-Smith, 1990), more time to get to know their children and families, thus enabling them to better meet children's needs (Elicker & Mathur, 1997). Both parents and teachers whose children were enrolled in all-day kindergarten were generally satisfied with the programs and believed that all-day kindergarten better prepared children for first grade (Hough & Bryde, 1996).

There seem to be many positive learning and social/behavioral benefits for children in all-day kindergarten programs. The potential benefits of a longer kindergarten day can be attributed to the increased amount of time children spend at school, but more importantly, to the *way* in which the extra time is spent. It is argued by some researchers that longer school days for kindergartners will not have a positive impact unless the time is spent in developmentally and individually appropriate learning environments (Carpenter, 2000; Gullo, 2000). They recommended that full-day kindergarten programs take advantage of the longer day by providing child-centered, developmentally appropriate activities and offer a balance of small group, large group, and individual activities. This viewpoint suggests that in order to prepare children academically, class time should be focused strategically on the specific academic skills appropriate to prepare children for the next educational step.

The Present Study

However, despite extensive earlier studies, the relationship between small vs. large classes, full-day vs. part-day kindergarten program organizations and young children's academic achievement is still ambiguous. The class size research is particularly mixed and the length-of-school-day research is not consistent, either. For instance, some study favors half-day over whole-day programs (see Terens, 1994). One limitation of previous research concerns the methods. Research that uses randomized experimental study may be limited methodologically, in terms of the generalizability of results; and pragmatically, in terms of policy recommendations. On the other hand, there are also immense practical and financial difficulties in setting up large-scale experimental studies to compare small- and large-classes, full-day vs. part-day differences. Another limitation has to do with the categorization of class size. Studies that compare selected class sizes (e.g., in the STAR project, class sizes of 13-17 were compared with class sizes of 22-26) concern generalizing to class sizes that fall outside the ranges studied.

As the cost of smaller classes and full day programs is high, requiring investment which is unlikely to be forthcoming unless the evidence that positive outcome is substantial and consistent, in this article we'll further investigate the relationship between two kindergarten program characteristics (class size and length of school day) to first-time kindergartners' cognitive skills at the end of the kindergarten year. The purpose of our study is to find out what gains children made from the beginning of the kindergarten year to the end of the year by the two kindergarten program

organizations, and whether there is a relationship between the score gains and the program characteristics. We describe the relationships of these features to children's achievement gains from fall to spring of the kindergarten year after adjusting for child and family background characteristics. The aim here is to present a simple, parsimonious model of the relationship between kindergarten program organizations and student achievement.

Methods

Data Source

Recently, the National Center of Education Statistics (NCES) recognized that knowledge regarding kindergarten was limited (West, Denton, Germino-Hausken, 2000). To address this gap, NCES began the Early Childhood Longitudinal Study—Kindergarten Class of 1998-1999 (ECLS-K), which studied 22,000 first-time kindergartners across the nation using interviews/questionnaires for parents and teachers and direct child assessments. The sample supports separate estimates and analyses of African American, Hispanic, White, Asian and Pacific Islander children, as well as children from different socioeconomic levels. The children attended both public and private kindergartens that offered full-day and part-day programs. When appropriately weighted, the sample is representative of the 3,866,000 children enrolled in kindergarten in the year of 1998-99.

Because of its ongoing, large-scale and nationally representative nature, the data has the potential to mitigate some of the limitations of previous class size and program type research. The information it contains is extensive to researchers who need to study the effect of kindergarten program organizations on young children's cognitive skills, therefore, is appropriate to answer our research questions.

Measures

Selection of samples. This study focuses on children who were first-time kindergartners, who didn't change schools and teachers during the kindergarten year, and who had both rounds of child assessment data. Consequently, those children who were repeaters or who attended a transitional kindergarten, who changed schools or classes during the kindergarten year, who couldn't take part in the assessments due to limited English proficiency, were excluded. Our final target sample includes 15,577 children.

Dependent variable. The dependent variable is the three cognitive gains (reading gain, math gain and general knowledge gain) children made during the kindergarten year. These scores are based on IRT (Item response theory) scale scores with a reliability (IRT-based theta) of 0.9 for reading and math, 0.88 for general knowledge (The National Center for Education Statistics, 2001). The use of IRT scale scores from an adaptive test alleviates the usual concerns about analyzing gain scores (e.g., floor and ceiling effects). To simplify the analysis procedure, the three cognitive gains were factor-analyzed to create a composite (alpha = .72) of mean kindergarten score gain. The factor loadings ranged from .54-.75.

Independent variables. There are two independent variables: 1) program type, taken from base year child data with three program types (am, pm and all day), collapsed into two broad types: part-day vs. full-day; 2) class size, constructed by making three composites from am, pm and all day kindergartens and then merge the three

files to create a total weighted number of 1,249 classes, coded into three class groups: "small" class group of 17 or fewer children, "medium" group of between 17-24 children and a large group of 24 or more children. (Note 1) About 23 percent of the children in this study were in a "small" class and an approximately 29% were in a class with 24 or more children (this was used to define the "large" class size group).

Control variables. In this study, children's gender, family structure, race and poverty level were used as control variables. The race/ethnicity indicator was constructed from parent-reported race/ethnicity information, which included eight categories. We classified children into five categories: White, African American, Hispanic, Asian and Other Race. Each category was coded 1 for the designated race and 0 for the non-designated races, with the Whites served as the comparison group. Poverty status is based on the federal government's poverty threshold, which is calculated using household income and the number of people living in the household. The family structure was coded into single-headed household and two-parent household, with single parent coded as 1 and the others 0.

Analysis Procedure

The first step is descriptive analysis. In order to compare kindergarten program organization effects, we present the results in effect size (*SD*) units. (Note 2) In this way, readers may compare the magnitudes of the effects in a common metric, beyond assessing their statistical significance.

The next step is to establish to what extent children's cognitive gains are related to differences in kindergarten program organizations. We began our analyses by providing the mean score gains of different groups of children by the two broad kindergarten program characteristics, subdivided into small, medium and large class sizes, part-day and full-day programs. Then the relationship between the child, family and each of the classroom characteristics to children's academic growth was examined by building up three regression models to compare the relationship between the mean of the gain score and the independent variables. The independent variables were entered successively to compare the changes in R-squared and variations in regression coefficients after adjusting for child and family background characteristics.

During the analysis, data were weighted using the base-year child-level weight designed for analyses involving child, parent, and teacher data. To adjust our weights in such a way as to have standard errors reflect the actual sample size (as opposed to the size of the reference population), we divided the weight of each case by the sample mean of BYCOMW0. Also, because ECLS-K employed a cluster sampling design, and because commonly available statistical software packages assume that data were collected through simple random sampling, we also adjusted each weight in such a way as to correct for design effects. After weighting, our full sample of 15,577 cases was equivalent to a simple random sample of 8,286 cases and our tests of statistical significance reflected a sample of this size.

Results

The descriptive information as presented in Table 1 shows that on average, public school children attending a regular kindergarten program for the first time during 1998-99 kindergarten year have an IRT cognitive score gain of 7.87. Among the

racial/ethnic groups, about 60% of the sample was White, 14% was African American, 16% Hispanic, 4% Asian and the remaining 6% consisted of other racial/ethnic groups. A slightly higher percentage of children were in full-day programs than in part-day programs. 23% of children came from single-parent family and 17% from below poverty household.

Table 1
Descriptive Statistics for the First-Time Kindergartners'
Background Characteristics and Kindergarten Program Organizations

	M	SD
Score gain		
All kindergartners	7.87	3.66
Gender		
Male	.50	.50
Female	.49	.50
Race		
White	.60	.49
Black	.14	.35
Hispanic	.16	.37
Asian	.04	.22
Other	.06	.24
Family Type		
Single parent household	.23	.42
Two-parent household	.77	.40
Income Level		
Above poverty	.83	.34
Below poverty	.17	.38
Class Size		
Small, <17	.23	.42
Medium, 17-24	.48	.45
Large, > 24	.29	.40
Length of Day		
Part-day	.46	.47
Full-day	.54	.49

Table 2 presents the fall and spring cognitive achievement gains by program organizations. These gain scores are useful as longitudinal measures of change because they show not only the extent of the gains, but also in which program

organization the gains are taking place. The result indicated that although all kindergartners made gains during the year, there were some differences in the gain scores that were related to child and family characteristics. Specifically, among the three class sizes, Asian children in small class made the greatest gains—approximately an effect size of .36 *SD* between small and large class, .27 *SD* between small and medium class. African American and Other Race children in small classes had the second highest score gains next to Asians. Their gains represented an effect size of .27 *SD* between small classes and large classes. The other groups—White children, poor and nonpoor children, children from two-parent families, boys and girls—all made slightly higher gains in small classes. Hispanic children and children from single parent families, however, did not make any gains in small classes.

Another kindergarten program feature, the length of day, has a pattern that is more evident than class size: *all* children made gains in full-day program, and that *minority* children made higher gains in full-day program than White children. This finding has important policy implications for fostering minority children's achievement. The higher gains in full-day program could be interpreted as effect sizes of .21 *SD* for Asian children, .18 *SD* for Other Race children, .16 *SD* for Black children, and .12 *SD* for children from two-parent households, respectively. The other groups of children in full-day program all have slightly higher gain scores than their counterparts in part-day programs, with an effect size of about .10 *SD* in the mean gain scores.

Overall, children in small classes made greater gains than those in medium or large classes, with those in large classes made the least gains. In respect to full-day and part-day program types, all children in full-day program had higher cognitive gain scores than those in part-day program. Although the effect sizes between the gains were small, they should be considered important, as the variations between gain scores of different groups may not be as great as other scores.

Table 2
First-Time Kindergartners' Mean Achievement Gains by
Program Characteristics

	Total	Class Size			Length of Day	
	(n = 8,286)	Small (n = 289)	Medium (n = 589)	Large (n = 371)	Part-day (n=3,773)	Full-day (n= 4,512)
Gender						
Male	7.87 (3.69)	8.04 (3.40)	7.70 (3.44)	7.65 (3.30)	7.66 (3.69)	8.05 (3.68)
Female	7.86 (3.64)	7.90 (3.57)	7.66 (3.40)	7.50 (3.21)	7.66 (3.54)	8.02 (3.71)
Race						
White	7.83 (3.61)	8.15 (3.42)	7.68 (3.41)	7.58 (3.25)	7.63 (3.51)	8.03 (3.69)

Black	6.91 (3.60)	7.90 (4.03)	7.17 (3.54)	6.90 (3.14)	6.49 (3.46)	7.09 (3.65)
Hispanic	7.94 (4.21)	7.33 (3.69)	7.38 (3.28)	7.20 (3.52)	7.80 (4.32)	8.09 (4.09)
Asian	8.74 (3.74)	9.26 (5.36)	8.37 (3.48)	7.91 (3.72)	8.41 (3.66)	9.23 (3.82)
Other	7.70 (3.43)	7.82 (2.76)	8.15 (3.74)	6.91 (2.81)	7.44 (3.28)	8.07 (3.61)
Family Type						
Two parent	7.83 (3.60)	7.97 (3.59)	7.68 (3.34)	7.61 (3.26)	7.58 (3.54)	8.03 (3.63)
Single parent	7.89 (3.87)	7.75 (3.24)	7.25 (3.68)	8.06 (3.41)	7.80 (3.86)	7.97 (3.89)
Income Level						
Above poverty	8.00 (3.64)	8.03 (3.41)	7.74 (3.44)	7.65 (3.24)	7.79 (3.58)	8.18 (3.67)
Below poverty	7.21 (3.72)	7.58 (3.95)	7.12 (3.26)	7.04 (3.36)	7.03 (3.70)	7.36 (3.73)

Note. 1) Standard deviations (SD) are presented in parenthesis; 2) The total number of the kindergartners has been weighted using the normalized base-year weight, BYCOMW0.

Table 3 presents the relationship of these score gains by the child, family and program characteristics in three Ordinary Least Squares regression models. In step 1 all background information was entered and this predicted an adjusted R-squared change of 16.3%. Among the background variables, minority children (Black, Hispanic and Other Race children) scored lower in spring cognitive gains in comparison with the White children. Children from below-poverty level families also scored lower than those from above-poverty level families. The differences in gain scores between Asian and White children, children from single-parent families and two-parent households, boys and girls, however, were insignificant.

In respect to the relationship between kindergarten program organizations and children's cognitive gains at the end of the kindergarten year, the results suggest that, after family background is controlled, there are differences in gain scores that are associated with characteristics of the program a kindergartner attends. The most substantial result is that full-day kindergarten program predicted higher cognitive gains compared to part-day kindergarten (ß = .19, p < .000). Entering of the dummy variable *full-day program* resulted in the greatest R-squared change (19.6%) of the three models—an increase of 2.5% than the previous model. This finding is consistent with previous literature about the positive effect of full-day program on students' academic achievement (de Costa & Bell, 2001; Cryan, Sheehan, Wiechel, & Bandy-Hedden, 1992; Elicker & Mathur, 1997; Fusaro, 1997; Gullo, 2000; Koopmans, 1991).

Table 3
Multiple Regressions of the Relationship between
Kindergarten Program Organizations and
First-Time Kindergartners' Mean Achievement Gains

	Total	Class Size			Length of Day	
	(n = 8,286)	Small (n = 289)	Medium (n = 589)	Large (n = 371)	Part-day (n=3,773)	Full-day (n= 4,512)
Gender						
Male	7.87 (3.69)	8.04 (3.40)	7.70 (3.44)	7.65 (3.30)	7.66 (3.69)	8.05 (3.68)
Female	7.86 (3.64)	7.90 (3.57)	7.66 (3.40)	7.50 (3.21)	7.66 (3.54)	8.02 (3.71)
Race						
White	7.83 (3.61)	8.15 (3.42)	7.68 (3.41)	7.58 (3.25)	7.63 (3.51)	8.03 (3.69)
Black	6.91 (3.60)	7.90 (4.03)	7.17 (3.54)	6.90 (3.14)	6.49 (3.46)	7.09 (3.65)
Hispanic	7.94 (4.21)	7.33 (3.69)	7.38 (3.28)	7.20 (3.52)	7.80 (4.32)	8.09 (4.09)
Asian	8.74 (3.74)	9.26 (5.36)	8.37 (3.48)	7.91 (3.72)	8.41 (3.66)	9.23 (3.82)
Other	7.70 (3.43)	7.82 (2.76)	8.15 (3.74)	6.91 (2.81)	7.44 (3.28)	8.07 (3.61)
Family Type						
Two parent	7.83 (3.60)	7.97 (3.59)	7.68 (3.34)	7.61 (3.26)	7.58 (3.54)	8.03 (3.63)
Single parent	7.89 (3.87)	7.75 (3.24)	7.25 (3.68)	8.06 (3.41)	7.80 (3.86)	7.97 (3.89)
Income Level						
Above poverty	8.00 (3.64)	8.03 (3.41)	7.74 (3.44)	7.65 (3.24)	7.79 (3.58)	8.18 (3.67)
Below poverty	7.21 (3.72)	7.58 (3.95)	7.12 (3.26)	7.04 (3.36)	7.03 (3.70)	7.36 (3.73)
		Model 1		**Model 2**		**Model 3**
Gender						
Female		.02		-.02		-.01
Race						

Black	-.21***	-.18***	-.19***
Hispanic	-.23***	-.19***	-.21***
Asian	-.03	.04	.05
Other	-.10***	-.05*	-.09*
Poverty Level			
Below poverty	-.21***	-.18***	-.17**
Family Type			
Single parent	.02	.00	.01
Class size			
Small, <17		.03*	.04*
Medium, 17- 24		.05*	.05*
Length of day			
Full day			.19***
Adjusted R-squared	16.3%	17.1%	19.6%

Note. *p < .05, **p < .01, ***p < .001.

Among the three kindergarten class sizes, children in small and medium classes did better than those in large classes (ß ranges from .03-.05 for small and medium class sizes in Model 2 and Model 3, p < .05), while children in large classes (more than 24) made least gains. Therefore, although the evidence is still not substantial, children in small and medium classes have potential advantages over those in large to very large classes. The relationship between class characteristics and academic achievement supports the second line of the study we have reviewed, that is, small classes have some slight effect on achievement (Berlin & Cienkus, 1999; Folger & Breda, 1989; Lindjord, 1998). And, consistent with Berlin and Cienkus (1999; Tomlinson, 1990), the slight positive effect existed after race and other background variables are controlled.

In sum, all children, regardless of child, family and classroom characteristics, are learning new skills and abilities during the kindergarten year. The study supports past findings that young children in full-day kindergarten made greater achievement gains and those in large classes made the least gains. This pattern is more pronounced for children from minority and low-income families. This suggests that some kindergarten program features can make a difference in knowledge gains and that kindergartners' achievement gains are not the same for all children, some of the variation can be explained by characteristics of the children's kindergarten program organizations and children's individual and family background.

Discussion and Implications

To date, findings regarding class size and length of school day on young children's achievement are contentious. In this paper, connections between class size (small, medium and large), length of school day (part- and full-day) and kindergartners'

cognitive score gains have been explored. The use of an ongoing, large-scale, nationally representative sample avoids many of the limitations found in the previous studies. For instance, the large sample enables us to consider all possible ranges of class sizes instead of just comparing small classes with very small classes and therefore offers little to help those seeking information on the range of class sizes actually experienced by the majority of teachers and children. The results of the study have the following policy implications:

The first implication concerns the differential impact of program organizations on the different academic developmental status among children from different backgrounds. This suggests that decision makers should seriously consider such factors when determining kindergarten program organization policies. Rather than mandate across-the-board policies to reduce class size or prolong school day, it may be more productive to attempt to align these organizations with students' background factors. More specifically, the legislature may want to target low-performing schools for smaller class size and longer school day.

Second, this study does not find the strong benefit for achievement associated with being in a small class (up to 17) that has been found in other studies. However, the slight gains associated with small and medium sizes suggest that smaller classes have potential advantages over the larger ones (Boyd-Zaharias, 1999; Grissmer, 1999), although it is difficult to identify any specific circumstances in which small classes are particularly effective. There is much we do not understand about the effects of smaller classes yet. Nevertheless, the study also indicated that children in large to very large classes made the least gains. The question of reducing class size therefore cannot be overlooked. The ratio recommended by the National Association of Young Children (NAEYC) is 25 children to two adults (Bredekamp & Copple, 1997), and the National Education Association (NEA) recommends a maximum number of fifteen children in a classroom (NEA, 2003). However, our descriptive study shows that only 23% first-time kindergartners were in small classes of fewer than 17 children, about 29% are still in large classes of more than 24 children. Thus, policy efforts should consider reducing large or very large class sizes to medium or small class size to benefit child learning.

Third, as found in other studies (Cryan, Sheehan, Weichel, & Bandy-Hedden, 1992; Fusaro, 1997; Gullo, 2000), children in a full-day kindergarten program generally made greater gains in three cognitive skills compared to children in part-day kindergarten. A major benefit of a longer kindergarten day may be that it allows teachers to get to know their students better. In other words, the longer day gives teachers the opportunity to develop a more complete and more multifaceted program. Children can get more involved in the planning of activities because there is more flexibility in the daily schedule. Process-oriented activities, which often require extended time, may be scheduled in large blocks.

Finally, the study also finds that minority and low-income children had greater score gains in smaller classes and full day programs. This has important policy implications. Providing full-day kindergarten, small class has long been considered an effective approach for improving minority achievement (Folger & Breda, 1999; Huck & Cormier, 1996; Lindjord, 1998; Tomlinson, 1990). The study suggests that full-day kindergarten should be made available immediately in schools serving pupils coming from predominately disadvantaged backgrounds. It appears that pupils coming from these sorts of social or economic conditions may have the greatest opportunity to gain in order to be prepared to "enter school ready to learn" (U. S.

Department of Education, 1994).

All research has limitations. For this study, despite its potential, the data source—the ECLS-K surveys—is limited in the following aspects: (a) The non-experimental nature of the data cannot establish causal relationships between independent variables and outcomes to the same degree of confidence that randomized experiments could, but randomized experiments are missing and non-experimental analyses are the best evidence available; (b) the use of cross-sectional data of kindergarten year in this study lacks the multiple points to make better generalizations about the program organizations and children's achievement; (c) although the composite "class size" has been constructed from a total of 12 variables to compensate for the missing data, it still has more missing data than the other variables and the validity of the result may be undermined to some extent.

Future Directions

A broader range of variables needs to be assessed to determine the impact of small class size and whole-day kindergarten programs on student achievement. Some areas need to be examined are a kindergarten student's ability to observe, discover, generalize, experiment, and solve problems as a result of attendance in different program organizations. Whole-day and small-class students' ability to express thoughts and feelings more creatively through language, movement, music, and art also need to be compared.

Other variables that need to be studied include the kindergarten curriculum, class size, socioeconomic status, student attendance patterns, education of parents, and cultural values. Also, the instructional strategies used by teachers and the effect of increased instructional time are of concern. Without alignment between program type, class size and teaching strategy, it is unlikely that investments in smaller classes, full-day programs will yield the expected benefits in student achievement. Professional development opportunities should focus on providing this type of information to teachers so that they can make the best instructional decisions possible for their classes (Blatchford, Moriarty, Edmonds, & Martin, 2002).

Notes

1. This coding has taken into consideration all ranges of class sizes, thus avoided the limitation in the STAR project, which included only small class sizes of 13-17 and large class sizes of 22-26.

2. Presentation and discussion of empirical results in effect-size units are common. We follow the standards suggested by Huck & Cormier (1996): effects that are .5 *SD* or more in magnitude are considered large; effects in the .3-.5 *SD* are moderate; effects that are .1-.3 *SD* are small; and those below .1 *SD* are trivial. We find it useful to compare effect size magnitude using these guidelines, which allows us to make substantive interpretations from group mean differences.

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